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the shell membrane is tough, and the white very sticky. Before studying his eggs he took them to Williamstown, Mass., but before arriving there they had undergone a part of their development, and the neural folds had nearly completed their coalescence.

ANATOMY OF BIRDS.—Mr. F. E. Beddard (*P. Z. S.*, London, 1888) gives an account of the alimentary tract and syrinx of *Balæniceps rex*, from which, and from the previously known osteological peculiarities, he regards this bird, "in fact, as a rather aberrant heron, having no near affinities with the storks, nor to Scopus." In the same volume he has some notes on the visceral anatomy of the penguins and puffins, dealing especially with the oblique septum of these birds, and the morphological and taxonomic conclusions to be drawn therefrom. He is inclined to homologize it in details with a fibrous and even muscular structure found in the crocodile. Dr. R. W. Schufeldt (*Jour. Comp. Anat. and Surgery*, October, 1888) gives a much needed account of the osteology of the Jungle-fowl, *Gallus bankiva*. He also treats of several other important structures in the same bird, which is of especial interest as being the ancestor of all of our domestic fowl. Some thirty process figures illustrate the chief points in the article.

ENTOMOLOGY.[1]

COLOR-RELATIONS BETWEEN PUPÆ AND THEIR SURROUNDINGS.—Students of Lepidoptera often observe variations in the color of different pupæ of the same species, that have apparently been caused by the color of the object to which the pupa is attached. Striking instances of these variations came under the observation of the writer during the past summer, when breeding *Papilio asterias*. Pupæ attached to green leaves were bright green in color, while others attached to the sides of a breeding-cage closely resembled in color the wood upon which they were.

This class of phenomena has been made the subject of careful study by several English entomologists. The more important of the papers published are two in number. The first, by Mr. E. B. Poulton,[2] was read before the Royal Society of London last year. Since that time Mr. George C. Griffiths has carried the matter farther, and the results of his experiments have just been published by Mr. William White.[3]

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[1] This Department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Philosophical Transactions, Vol. clxxviii., B., 1887, pp. 311-441.

[3] Trans. Entomol. Soc., London, 1888, pp. 247-267.

Previous to these writings, observers had freely stated that it was the habit of chrysalides to assume the precise coloration of the surface to which they were attached, and the untested facts of the case had been considerably exaggerated. In explanation of the phenomena in question, the earlier writers held that these correspondences of color were analogous to those of the Chameleon, or that they were photographic. Attention was called to the transparent surface of the freshly formed pupa, which might be sensitive to light. Professor Meldola, however, had modified such statements by declaring [1] that "the action of light upon the sensitive skin of a pupa had no analogy with its action on any known photographic chemical. No known substance retained permanently the color reflected on it by adjacent objects."

This represents the state of our knowledge at the time of the publication of Mr. Poulton's memoir. In this paper the results of many experiments are tabulated. Some of them are very striking. Thus, in the case of pupæ of *Vanessa*, exposed to gilded surroundings, many of them appeared as if they had been covered with gold leaf. This memoir is a difficult one to abstract, owing to the great amount of details. The following appear to be the more important conclusions:—

1. There is a great difference with regards to the sensitiveness of different species. Thus he proves that the pupæ of the following named butterflies possess an adjustable color-relation to their surroundings: *Vanessa io, V. urticæ, V. atalanta, Pieris brassicæ,* and *P. rapæ,* while, on the other hand, dimorphic pupæ, which are closely allied to the sensitive forms, may be uninfluenced by surrounding colors, *e.g.: Papilio machaon* and *P. polydamus.* In the genus Ephyra (Heterocera) the dimorphic pupæ are quite uninfluenced by their surroundings, the pupal colors corresponding to those of the dimorphic larvæ.

2. The previously accepted theory, which explained the pupal color-relation as following from the action of light upon the moist skin of the freshly-formed pupa, is entirely disproved, and it is shown that the influence works upon the larva during the period which intervenes between the cessation of feeding and pupation. This intervening period was carefully investigated in *V. urticæ,* and it was found that, after ceasing to feed, the larvæ wander for a variable time, then rest for about fifteen hours upon the surface selected for pupation, and finally hang suspended, head downwards, for about eighteen hours, after which time pupation takes place. By transferring the larvæ from one color to another, it was found that the color influence works for about twenty hours preceding the last twelve hours of the whole period.

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[1] Proc. Entom. Soc., London, 1874, p. XXIV.

3. Blinding proved that the eyes do not form the organs which are influenced, and it was also shown that the complex bristles do not contain a terminal organ with this function. Experiments with conflicting colors appear to prove that surrounding colors affect the whole surface of the larval skin, although parti-colored pupæ were not obtained. (There is, however, some evidence of such a result in *Papilio nireus.*)

4. In all cases there are certain colors which produce no effects. In Vanessa the brilliant metallic tints of the pupæ can be greatly influenced by the presence of gilded surfaces in the environment of the larva before pupation. This fact appears to prove that the metallic tints are essentially protective, and probably subserve concealment by their resemblance to glittering minerals, such as mica. This theory is confirmed by observations upon the habits of certain species with gilded pupæ. At the same time the gilded appearance has acquired another and opposite significance in other species, being of use in rendering the pupæ conspicuous, and thus acting as a signal of an unpleasant taste or smell.

5. The amount of pigment in the superficial layer of the cuticle in the pupæ of *Pieris brassicæ* and *P. rapæ* appears to be influenced by the spectroscopic composition of the light incident upon the larvæ before pupation.

The experiments of Mr. Griffiths, as summarised by Mr. White, confirms Mr. Poulton's observations in the following particulars: (1) Dark surroundings exercise a retarding influence upon the period before pupation. (2) The freshly-formed pupa is *not* photographically sensitive, but the period during which the larva rests motionless upon the selected surface is the time of chief susceptibility. (3) The general results of the colors themselves also entirely confirm Poulton's observations, notably in the case of dark pupæ produced by black, and of green pupæ produced by yellow. (4) The special effects of yellow surroundings in arresting the formation of dark superficial pigment, and in tending towards the production of green pupæ, were very striking, and confirm Poulton's suggestion that rays from this part of the spectrum, when predominant in the light incident upon the susceptible larva, determine the production of these results whenever green pupæ are produced by the influence of surroundings. When green pupæ of Pieris are produced, as in nature, on green leaves, it is probable that the effect is wholly due to the reflected yellow rays. Though these experiments do not exactly furnish materials for new conclusions, they are valuable as independent corroborations of Poulton's results.

SERIOUS INJURY TO APPLES BY THE PLUM CURCULIO.—During the latter part of the past summer my attention was attracted to a serious injury done to the fruit in an apple-orchard through which I passed daily. A large proportion of the apples in one corner of the orchard had been eaten into by something which made small pits from one-eighth to one-fourth inch in diameter, and of about the same depth. On one tree nearly every apple had been attacked, and in many cases there were ten or twelve holes in a single apple. The injury was so serious as to render the fruit in this part of the orchard unmarketable.

The holes in the apples were first observed during the latter part of August. At that time many of them were partially grown over, while others were fresh, indicating that the pest had been at work for a considerable time, and was still active. As the injury to the apples resemble somewhat that caused by a climbing cut-worm, that sometimes infests apples in western New York, I at first searched for caterpillars, and gave little thought to the plum curculios that I frequently found hiding in the pits in the apples. But, after finding a considerable number of these insects in these pits, it occurred to me that they might be the cause of the mischief. Several perfect apples were then selected and placed in breeding-cages, in each of which were confined several curculios. The question was soon settled. Within twenty-four hours the beetles had begun to eat into the apples. They made small holes at first, but these were soon enlarged so as to form pits of the size indicated above.

The results of this experiment are of special interest at this time as confirming the observations referred to in the next note.—*J. H. Comstock.*

POISONING THE PLUM CURCULIO.—In referring to some experiments made by me to prevent curculio injuries, in the August NATURALIST, the question is raised as to how spraying with poisons may have a preventive effect on this insect. I believe that a satisfactory explanation may now be given. Early last June I confined an adult curculio in a jar with a large green plum, and was surprised at the avidity with which the fruit was eaten. A large portion of the surface was gnawed out for food, and not for purposes of oviposition, and the feasibility of poisoning the adult beetles by coating the fruit with poison is clearly shown.

But even more satisfactory breeding-cage experiments were made in Illinois, by Professor Forbes, who informs me that he has found that, besides gnawing out the fruit, the adult curculio eats freely of the substances of the leaves. He adds that the curculios "are certainly very freely exposed to destruction by poison, without reference to the habits of oviposition or the first food of the larvæ;" and that he has "also learned experimentally that spraying the leaves with Paris green would poison the beetles completely."

Professor Forbes discussed at some length the details of his experiments, which confirm the conclusions reached in my experiments, in an address delivered at a meeting of the Central Illinois Horticultural Society during last August. (*Prairie Farmer*, August 11, 1888.) Professor A. J. Cook, of the Michigan Agricultural College, also announces, in Bulletin No. XXXIX., similar results.—*Clarence M. Weed, Ohio Agricultural Experiment Station.*

SMITH'S MONOGRAPH OF THE SPHINGIDÆ OF TEMPERATE NORTH AMERICA.—Parts II. and III. of the current volume of the *Transactions of the American Entomological Society* are devoted to a "Monograph of the Sphingidæ of Temperate North America," by Mr. John B. Smith. This paper makes a volume of nearly 200 pages. It appears to be very complete, and very carefully written. The synonymy of each species is given; the adult is fully described, and descriptions of the early stages are also given whenever they are known. The work abounds in valuable critical notes. Analytical keys for the separation of genera and of species are furnished. The paper concludes with a synonymical list. Eighty species are enumerated in this list. This work should be in the hands of every student of American Lepidoptera.

EMBRYOLOGY.[1]

DEVELOPMENT OF MELOE.—Josef Nusbaum describes briefly (*Biol. Centralblat.*, VIII., p. 449-452) the development of the oil beetle, Meloe. This form is very convenient for embryological studies as it breeds well in confinement and lays little piles of eggs, all the eggs in a single pile developing synchronously. The segmentation nucleus is central and the cells resulting from the segmentation migrate slowly to the surface, the protoplasm forming a reticulum in the meshes of which the yolk is embraced. Some of these cells reach the surface to form the blastoderm while others remain behind to form "yolk cells." On the third day the ventral plate and the rudiments of the amnion appear very early the ventral plate becomes segmented, and paired appendages appear on every segment of the body. The primitive groove appears at the same time as the amnion and develops from behind forward. It soon closes and forms a tube with a very narrow lumen behind, in front a solid cellular in-pushing. This is regarded as gastrulation, and the portion thus invaginated as ento-mesoderm or primary entoderm,

[1] Edited by Prof. John A. Ryder, Univ. of Penna., Philadelphia.